

## *Penn Cambria Curriculum*

<b>Course Name</b>	<b>Physical Science</b>
<b>Length of Course</b>	1 credit (1 period per day for 1 semester)
<b>Grade Level</b>	11-12
<b>Prerequisites</b>	None (No previous Chemistry or Physics credits earned)
<b>Course Description</b>	Physical science is designed to provide vocational students with an understanding of the physical sciences, specifically chemistry and physics. Students will study the scientific method, matter and energy, atomic theory, the periodic table, chemical reactions, motion, machines, force, work, waves, heat, and electricity. The course incorporates hands-on laboratory experiments and activities to reinforce principles. Although mathematics is not emphasized, algebra skills are required.
<b>Units of Study</b>	Nature of Science Matter: It's Properties and Behaviors Atomic Structure and the Periodic Table Chemical Bonding and Reactions Motion and Energy Work, Machines, Energy, and Heat Waves and Electricity
<b>Materials</b>	Text: <u>Science Spectrum: Physical Science</u> . Holt, Rinehart, and Winston. 2004 Supplemental Materials: Labs from various sources

*At Penn Cambria High School, all core subject courses are aligned to the Pennsylvania Academic Standards and focus on ensuring students have a solid understanding of core concepts. In addition, all courses encourage critical thinking and an in-depth analysis of subject matter.*

## **Unit: Nature of Science**

**Estimated Time: 1-2 weeks + ongoing application**

**Standard Alignment:**

3.1.12D – Analyze scale as a way of relating concepts and ideas to one another by some measure.

3.2.12A – Evaluate the nature of scientific and technological knowledge.

3.2.12B – Evaluate experimental information for appropriateness and adherence to relevant science processes.

3.2.12C – Apply the elements of scientific inquiry to solve multi-step problems.

3.7.12B – Evaluate appropriate instruments and apparatus to accurately measure materials and processes.

**Curricular Objectives:**

The student will be able to:

- Distinguish between scientific facts, principles, theories and laws.
- Describe how relationships represented in models are used to explain scientific or technological concepts.
- Analyze the relationship between science and technology.
- Describe the steps of the scientific method.
- Use appropriate methods, instruments, and scale for precise qualitative and quantitative observations.
- Demonstrate the use of critical thinking and science process skills to solve problems.
- Identify types of graphs and demonstrate the ability to use the proper type of graph for the data being presented.

**Assessments/ Measurement of Objectives:**

- Objective quizzes and tests
- Lab activities and reports
- Student projects
- Problem solving activities
- Classroom and homework activities

**Suggested Methods of Instruction / Learning Activities:**

- PowerPoint lessons
- Vocabulary activities
- Case study or current event readings and analysis
- Density of Metals Lab
- Metric Measurement Lab
- Density of Water Lab
- Candle Observation Lab

<b>Unit: Matter and Its Properties and Behavior</b>
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**Estimated Time: 2-3 weeks**

**Standard Alignment:**

3.1.12 E – Evaluate change in nature, physical systems, and man-made systems.

3.2.12 A – Evaluate the nature of scientific and technological knowledge.

3.4.12A – Apply concepts about the structure and properties of matter.

**Curricular Objectives:**

The student will be able to:

- Describe the structure of the atom.
- Distinguish between physical and chemical properties of matter.
- Compare and contrast the differences among the four states of matter.
- Explain how the forces that bind solids, liquids, and gases affect their properties.
- Predict the behavior of gases through the application of laws.

**Assessments/ Measurement of Objectives:**

- Objective quizzes and tests
- Lab activities and reports
- Student projects
- Problem solving activities
- Classroom and homework activities

**Suggested Methods of Instruction / Learning Activities:**

- PowerPoint Lessons
- Vocabulary activities
- Case study or current event readings and analysis
- Physical and Chemical Properties Lab
- Mystery Powders Lab
- Paper Chromatography Lab
- Strike it Rich Lab
- Separating Mixture Lab
- Evidence of Chemical Reaction Lab
- Boyles Law Lab
- Charles Law Lab
- Gay-Lussacs Law Lab

<b>Unit: Atomic Structure and the Periodic Table</b>
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**Estimated Time: 4 – 5 weeks**

**Standard Alignment:**

3.4.12.A – Apply concepts about the structure and properties of matter

3.4.12.B – Apply and analyze energy sources.

**Curricular Objectives:**

The student will be able to:

- Describe the structure of the atom.
- Explain the development of the modern atomic theory.
- Explain the relationship between the physical properties of a substance and its molecular or atomic structure.
- Use isotopes to determine the number of protons, neutrons, and electrons.
- Compare mass number and average atomic mass.
- Relate the organization of the periodic table to the arrangement of electrons within an atom.
- Explain the repeating pattern of chemical and physical properties of the elements by using the repeating patterns of atomic structure within the periodic table.
- Locate various groups of elements on the periodic table.
- Identify types of nuclear radiation and their properties.
- Write and balance equations for nuclear decay.
- Calculate the half-life of a radioactive isotope.
- Distinguish between fission and fusion.
- List and explain both beneficial uses and possible risks of nuclear radiation.
- Compare and contrast the advantages and disadvantages of nuclear energy as a power source.

**Assessments/ Measurement of Objectives:**

- Objective quizzes and tests
- Lab activities and reports
- Student projects / research
- Problem solving activities
- Classroom and homework activities

**Suggested Methods of Instruction / Learning Activities:**

- PowerPoint Lessons
- Vocabulary Activities
- Case study or current event readings and analysis
- Videos
- Bright-line Spectra Demo
- Flame Test Lab
- Isotopic Pennies Lab
- Periodic Law Lab
- Activities of Metals Lab
- Metal, Nonmetal, Metalloid Lab
- Half-life Simulation Lab
- Element research activities

## **Unit: Chemical Bonds and Reactions**

**Estimated Time: 2-3 weeks**

### **Standard Alignment:**

3.4.12.A – Apply concepts about the structure and properties of matter.

3.4.12.B – Apply and analyze energy sources and conversions, and their relationships to heat and temperature.

### **Curricular Objectives:**

The student will be able to:

- Explain the formation of compounds and their resulting properties using bonding theories.
- Recognize formulas and names for simple inorganic compounds.
- Describe how the chemical structure of a compound affects its properties.
- Classify and describe, in equation form, types of chemical reactions.
- Recognize signs that a chemical reaction is taking place.
- Describe the differences between endothermic and exothermic reactions.
- Demonstrate how to balance chemical equations.
- Give examples of the Law of Conservation of Matter (atoms, mass)
- Describe factors that influence the frequency of collisions during chemical reactions that might affect reaction rates.

### **Assessments/ Measurement of Objectives:**

- Objective quizzes and tests
- Lab activities and reports
- Student projects
- Problem solving activities
- Classroom and homework activities

### **Suggested Methods of Instruction / Learning Activities:**

- PowerPoint Lessons
- Vocabulary Activities
- Case study or current event readings and analysis
- Ionic or Covalent Bonding Lab
- Solubility (Like Dissolves Like) Lab
- Evidence of a Chemical Reaction Lab
- Types of Chemical Reactions Lab
- Conservation of Mass Lab
- Endothermic/Exothermic Lab

## **Unit: Motion, Forces, and Energy**

**Estimated Time: 3 - 4 weeks**

### **Standard Alignment:**

- 3.1.12.E – Evaluate change in nature, physical systems, and man-made systems.
- 3.2.12.A – Evaluate the nature of scientific and technological knowledge.
- 3.2.12.B – Evaluate experimental information for appropriateness and adherence to relevant science processes.
- 3.2.12.C – Apply the elements of scientific inquiry to solve multi-step problems.
- 3.4.12.B – Apply and analyze energy sources and conversions, and their relationships to heat and temperature.
- 3.4.12.C – Apply the principles of motion and force.

### **Curricular Objectives:**

The student will be able to:

- Describe and calculate the motion of an object based on its time, distance, displacement, speed, and velocity.
- Describe the concept of acceleration and solve problems involving acceleration.
- Explain the effects of balanced and unbalanced forces on motion.
- Compare and contrast static and kinetic friction.
- Evaluate whether friction is helpful or harmful.
- State Newton's three Laws of Motion, give examples, and solve problems involving Newton's Laws of Motion.
- Demonstrate mathematically how free-fall acceleration relates to weight.
- Explain momentum and how force is related to change in momentum.
- Explain common phenomena using knowledge of conservation of momentum (ex. rock in landslide, car hitting patch of ice).

### **Assessments/ Measurement of Objectives:**

- Objective quizzes and tests
- Lab activities and reports
- Student projects
- Problem solving activities
- Classroom and homework activities

### **Suggested Methods of Instruction / Learning Activities:**

- PowerPoint Lessons
- Vocabulary activities
- Case study or current event readings and analysis
- Measuring Motion – Speed and Acceleration Lab
- Energy Conversions in a Bouncing Ball Lab
- Friction Lab
- Static, Sliding, and Rolling Friction Lab
- Testing Reaction Time Lab
- Determining the Coefficients of Static and Kinetic Friction
- Newton's First Law Lab
- How are Action & Reaction Forces Related Lab
- Measuring Forces Lab
- Conservation of Momentum Lab
- Determining Your Acceleration on a Bicycle

## **Unit: Work, Machines, Energy, and Heat**

**Estimated Time: 2 – 3 weeks**

### **Standard Alignment:**

- 3.1.12.A – Apply concepts of systems, subsystems, feedback, and control to solve complex technological problems.
- 3.1.12.D – Analyze scale as a way of relating concepts and ideas to one another by some measure.
- 3.1.12.E – Evaluate change in nature, physical systems, and man-made systems.
- 3.2.12.A – Evaluate the nature of scientific and technological knowledge.
- 3.2.12.B – Evaluate experimental information for appropriateness and adherence to relevant science processes.
- 3.2.12.C – Apply the elements of scientific inquiry to solve multi-step problems.
- 3.4.12.A – Apply concepts about the structure and properties of matter.
- 3.4.12.B – Apply and analyze energy sources and conversions and their relationship to heat and temperature.

### **Curricular Objectives:**

The student will be able to:

- Calculate the work done on an object and the rate at which work is done.
- Use the concept of mechanical advantage to explain how machines make doing work easier.
- Calculate the mechanical advantage of various machines.
- Name and describe the six types of simple machine and recognize simple machines within compound machines.
- Design or evaluate simple technological or natural systems that incorporate principles of force and motion (e.g. Simple machines, compound machine)
- Explain the relationship between energy and work.
- Calculate kinetic energy and gravitational potential energy.
- Identify various forms of energy and describe transformations of energy.
- Explain how heat relates to energy transfer.
- Investigate and demonstrate how energy is transferred by conduction, convection, and radiation.
- Solve problems involving specific heat.
- Describe the concepts of different heating and cooling systems.
- Compare different heating and cooling systems in terms of the transfer of usable energy.
- Explain the practical use of alternative sources of energy to address environmental problems.
- Using HVAC systems, give examples of renewable energy resources and non renewable energy resources and explain the environmental and economic advantages and disadvantages to their use.

### **Assessments/ Measurement of Objectives:**

- Objective quizzes and tests
- Lab activities and reports
- Student projects
- Problem solving activities
- Classroom and homework activities

### **Suggested Methods of Instruction / Learning Activities:**

- PowerPoint Lessons
- Vocabulary activities
- Case study or current event readings and analysis
- Sensing Hot and Cold Lab
- How Do Temperature and Energy Relate Lab
- Convection Lab
- What Colors Absorb More Radiation Lab
- Conductors and Insulators Lab
- Investigating Conduction by Heat Lab
- Energy Transfer and Specific Heat Lab
- Determining Better Insulators for Your Feet Lab
- What is Your Power Output When you Climb the Stairs Lab
- A Simple Inclined Plane Lab
- Is Energy Conserved in a Pendulum Lab
- Determining the Energy of a Rolling Ball Lab
- Exploring Work and Energy Lab
- Determining Which Ramp is More Efficient Lab
- Simple Machine Lab



## **Unit: Waves and Electricity**

**Estimated Time: 2 – 3 weeks**

### **Standard Alignment:**

3.1.12.E – Evaluate change in nature, physical systems, and man-made systems.

3.2.12.A – Evaluate the nature of scientific and technological knowledge.

3.2.12.B – Evaluate experimental information for appropriateness and adherence to relevant science processes.

3.2.12.C – Apply the elements of scientific inquiry to solve multi-step problems.

3.4.12.C – Apply the principles of motion and force.

### **Curricular Objectives:**

The student will be able to:

- Distinguish between mechanical and electromagnetic waves.
- Compare and contrast transverse and longitudinal waves.
- Compare waves in the electromagnetic spectrum and their properties, energy levels and motion.
- Relate waves to particle vibrations.
- Identify the characteristics of waves.
- Solve problems involving wave speed, frequency, and wavelength.
- Describe the Doppler effect.
- Explain what occurs when waves interact.
- Describe the formation and effects of an electric field.
- Explain how an electric charge is generated.
- Describe how batteries are sources of voltage.
- Explain and solve problems involving current, resistance, voltage, and electric power, using various laws including Ohm's Law.
- Distinguish between conductors and insulators.
- Distinguish between series and parallel circuits.
- Recognize the components in simple circuit schematic diagrams.
- Explain how electricity induces magnetism and how magnetism induces electricity as two aspects of a single electromagnetic force.

### **Assessments/ Measurement of Objectives:**

- Objective quizzes and tests
- Lab activities and reports
- Student projects
- Problem solving activities
- Classroom and homework activities

### **Suggested Methods of Instruction / Learning Activities:**

- Case study or current event readings and analysis
- How do Particles Move in A Medium Lab
- Polarization Lab
- Wave Speed Lab

- Modeling Transverse Waves Lab
- Creating & Measuring Standing Waves Lab
- Tuning a Musical Instrument Lab
- Wave Interference Lab
- Charging Objects Lab
- Using a Lemon as a Cell Lab
- How can Materials be Classified by Resistance Lab
- Series and Parallel Circuits Lab
- Constructing Electric Circuits Lab
- Investigating How the Length of a Conductor Affects Resistance Lab